BUCKLING OF NON-WELDED ALUMINIUM COLUMNS

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Abstract

A theoretical and experimental study of the maximum strength of initially curved non-welded and longitudinally welded aluminium columns has been carried out and in the light of which new aluminium column design curves were proposed.

In the theoretical study, a novel way of representing the stress-strain relationships of aluminium alloys was introduced. A number of new column programs were developed for existing steel column programs were developed from existing steel column programs, incorporating the non-linear inelastic stress-strain properties of aluminium and the combination of HAZ softening and residual stresses in welded aluminium columns. Using these programs, more than 150 theoretical curves were generated in the parametric studies which included the following parameters:

(1) initial out-of-straightness, (2) eccentricity of loading, (3) 0.2% proof stress $\sigma_{0.2}$, (4) knee factor n, (5) elastic modulus E, (6) section geometry – y/r, (7) asymmetry of cross section – y_1/y_2, (8) residual stress and (9) HAZ softening.

Altogether 26 non-welded and 30 welded 76 mm I-section columns of 6082-TF alloy were tested. The columns were tested with controlled initial out-of-straightness of magnitudes approximately equal to $\ell/1000$. There was very good correspondence between the experimental and the theoretical results for the non-welded columns; the agreement for the welded columns was less satisfactory.

Four basic design curves were proposed to cover the whole practical range of aluminium columns. According to the types of alloy, section geometry and welding condition, columns are divided into eight classes and assigned to the four basic design curves. The design curves were empirically chosen to fit theoretical curves and were supported by

column test results from the present work and other sources. They are expressed in a form most suited for incorporating into computer aided design programs.